

## **HIGH-DENSITY OPTICAL DISC AND RECORDING/REPRODUCING METHOD THEREOF**

### **BACKGROUND OF THE INVENTION**

#### **Field of the Invention**

5        The present invention relates to a high-density optical disc such as BD-RE (Blu-ray Disc Rewritable) or BD-ROM, and a recording/reproducing method thereof.

#### **Description of the Related Art**

10      Recently, high-density optical discs have been developed, for example, DVD (Digital Versatile Disc), which can store a large quantity of high-quality video and audio data. Currently, such high-density optical discs are widely commercially available.

15      On a DVD, main A/V data is recorded in the unit of sectors each having a size of 2,084 bytes, as shown in Fig. 1. In each sector of 2,048 bytes, additional information of 16 bytes is recorded which may include ID (Identification Data), IED (ID Error Detection Code), CPR\_MAI (Copyright Management Information), and EDC (Error Detection

Code).

The sector ID information, which is included in the additional information, consists of 4 bytes including 1-byte sector information and 3-byte sector number information, as shown in Fig. 2.

5 The 1-byte sector information includes sector format type information, tracking method information, disc reflectivity information, reserved information, data type information, and layer number information, each of which has a size of 1 bit. The sector information also includes area type information of 2 bits.

10 For example, where the sector formation type information corresponds to '0b', it represents that the main A/V data recorded on the associated sector can be reproduced or recorded by a CLV (Constant Linear Velocity) type. On the other hand, where the sector formation type information corresponds to '1b', it represents that 15 the main A/V data recorded on the associated sector can be reproduced or recorded by different types for different zones, respectively.

Also, where the tracking method information corresponds to '0b', it represents a pit-based tracking operation. On the other hand, where the tracking method information corresponds to '1b', it represents 20 a groove-based tracking operation. Where the disc reflectivity information corresponds to '0b', it represents a reflectivity of more than 40%. On the other hand, where the reflectivity information corresponds to '1b', it represents a reflectivity of not more than 40%.

25 Meanwhile, where the area type information corresponds to '00b', it represents that the current position corresponds to a data area. Also, where the area type information corresponds to '01b', it

represents that the current position corresponds to a lead-in area. The area type information corresponding to '10b' represents a lead-out area, whereas the area type information corresponding to '11b' represents a middle area on a dual layer optical disc. Where the data 5 type information corresponds to '0b', it represents that the main A/V data of the associated sector is read-only data. On the other hand, where the data type information corresponds to '1b', it represents that the main A/V data of the associated sector is data other than read-only data.

10       Also, where the layer number information corresponds to '0b', it represents that the current disc has a single layer or that the current layer is a first layer Layer 0 in a dual layer optical disc. On the other hand, where the layer number information corresponds to '1b', it represents that the current layer is a second layer Layer 15 1 in the dual layer optical disc.

Accordingly, once such a DVD is loaded in an optical disc apparatus, the optical disc apparatus reads sector format type information, tracking method information, disc reflectivity information, data type information, layer number information, and 20 area type information recorded on the DVD as sector information, in order to normally carry out a data recording or reproducing operation corresponding to the read information.

For example, servo control for data recording or reproduction should be determined in accordance with whether the sector formation 25 type information represents a CLV type or a different type having different linear velocities for respective zones. Also, the gain of a read signal should be determined in accordance with the disc

reflectivity information. Focus servo control also has to be determined in accordance with the layer information. Thus, the recording or reproducing condition should be determined in accordance with the additional information.

5        Meanwhile, standardization of new high-density optical discs such as BD-RE and BD-ROM has recently been conducted by associated companies. However, the data format of such BDs is essentially different from that of DVDs. Furthermore, there is no method for effectively and appropriately recording diverse information

10      corresponding to sector information, as recorded on a DVD, on the above mentioned high-density optical disc. Accordingly, such a method is strongly demanded.

#### SUMMARY OF THE INVENTION

The present invention has been made in view of the above-mentioned problems, and an object of the invention is to provide a high-density optical disc such as BD-RE or BD-ROM and a recording or reproducing method thereof in which diverse additional information corresponding to sector information, as used in a DVD, is efficiently recorded in a particular information field included in a data unit recorded on a burst cutting area of the high-density optical disc or a particular 1-byte address field included in an address unit recorded on the high-density optical disc so that it can be read when the high-density optical disc is loaded in an optical disc apparatus or when a data recording or reproducing operation for the high-density optical disc is carried out.

In accordance with one aspect, the present invention provides

a high-density recording medium, comprising: a burst cutting area; and a data area including an address unit, wherein additional information is recorded on at least one of the burst cutting area and the address unit, while the additional information being used 5 to control a recording or reproduction of the recording medium.

In accordance with another aspect, the present invention provides a recording/reproducing method for a high-density optical disc, comprising the steps of: identifying information recorded in a particular information field included in a data unit read from a 10 burst cutting area of the optical disc or in a particular address field included in an address unit read from the optical disc; and controlling a data recording or reproducing operation, based on the identified information.

#### BRIEF DESCRIPTION OF THE DRAWINGS

15 The above objects, and other features and advantages of the present invention will become more apparent after reading the following detailed description when taken in conjunction with the drawings, in which:

20 Fig. 1 is a schematic view illustrating the structure of a data frame in a general DVD;

Fig. 2 is a schematic view illustrating the structure of sector information in a general DVD;

Fig. 3 is a schematic view illustrating a BCA on a high-density optical disc according to the present invention;

25 Fig. 4 is a schematic view illustrating the structure of data units on a high-density optical disc according to an embodiment of

the present invention;

Fig. 5 is a schematic view illustrating one exemplary structure of a particular information field on the high-density optical disc according to the first embodiment of the present invention;

5 Fig. 6 is a schematic view illustrating another exemplary structure of a particular information field on the high-density optical disc according to the first embodiment of the present invention;

Fig. 7 is a schematic view illustrating the structure of an  
10 address unit on a high-density optical disc according to a second embodiment of the present invention;

Fig. 8 is a schematic view illustrating the structure of a particular address field on the high-density optical disc according to the second embodiment of the present invention;

15 Fig. 9 is a schematic view illustrating the structure of a physical ADIP (Address In Pre-groove) address on the high-density optical disc according to the first or second embodiment of the present invention; and

Fig. 10 is a schematic block diagram illustrating the  
20 configuration of an optical disc apparatus for recording data on the high-density optical disc or reproducing data recorded on the high-density optical disc according to the first or second embodiment of the present invention.

#### **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

25 Hereinafter, preferred embodiments of a high-density optical disc and a recording/reproducing method thereof according to the

present invention will be described in detail with reference to the annexed drawings.

The high-density optical disc according to the present invention may be either a BD-RE or a BD-ROM.

5 In accordance with a first embodiment of the present invention, diverse additional information required to enable a normal data recording or reproducing operation may be recorded on a burst cutting area (BCA) assigned to the high-density optical disc.

10 The BCA, which is assigned to the high-density optical disc, as shown in Fig. 3, is an innermost area that the optical disc apparatus first accesses when the high-density optical disc is loaded therein. On the BCA, diverse information such as enciphering information for anti-duplication of the disc is recorded in the form of a BCA code.

15 As shown in Fig. 4, the BCA code recorded on the BCA has a data structure in which a plurality of data units are successively recorded. Each data unit consists of data of 4 rows including a sync field of 1 byte and an information field of 4 bytes, and parity of 4 rows including a sync field of 1 byte and a carrier field of 4 bytes.

20 Meanwhile, diverse additional information corresponding to sector information, as used in DVDs and described with reference to Fig. 2, may be recorded in an optional information field in each data unit, for example, a first information field of each data unit,  $I_{0,0}$ ,  $I_{0,1}$ ,  $I_{0,2}$ , or  $I_{0,3}$ . For example, recorded in the first information field  $I_{0,0}$ , of each data unit written on the BCA of a BD-ROM may be 25 number-of-layers information of 2 bits (b7b6 = Number of Layers), disc reflectivity information of 2 bits (b5b4 = Reflectivity), reserved information of 1 bit (b3 = reserved), application indicator

information of 1 bit (b2 = Application Indicator), and data unit sequence number information of 2 bits (b1b0 = Data Unit Sequence Number), as shown in Fig. 5.

In this case, where the 2-bit number-of-layers information 5 'b7b6' corresponds to '00b', it represents that the associated optical disc has a structure consisting of one layer, that is, a single layer structure. Also, the number-of-layers information 'b7b6' corresponding to '01b' represents that the associated optical disc has a dual layer structure. On the other hand, where the 10 number-of-layers information 'b7b6' corresponds to '10b' or '11b', it represents that the associated optical disc has a triple layer structure having a third layer Layer 2 or a quadruple layer structure having a fourth layer Layer 3.

Where the 2-bit reflectivity information 'b5b4' corresponds to 15 '00b', it represents that the optical disc has a low reflectivity lower than a first predetermined reference value. Also, the reflectivity information 'b5b4' corresponding to '01b' represents that the optical disc has a middle reflectivity being higher than the first predetermined reference value and lower than a second 20 predetermined reference value, whereas the reflectivity information 'b5b4' corresponding to '11b' represents that the optical disc has a high reflectivity higher than the second predetermined reference value.

For reference, the recording density of a BD-RE or BD-ROM is 25 about 5 times as high as that of general DVDs. By virtue of such a high recording density, it is possible to allocate 2 bits to reflectivity information in the case of the BD-RE or BD-ROM, so that

the reflectivity information can be more finely defined. Accordingly, more appropriate OPC (Optical Power Control) and AGC (Automatic Gain Control) can be carried out during data recording and reproducing operations.

5       Where the 1-bit application indicator information 'b2' corresponds to '0b', it represents nonuse of an anti-duplication system. On the other hand, the application indicator information 'b2' corresponding to '1b' represents use of the anti-duplication system.

10      Also, where the 2-bit data unit sequence number information 'b1b0' corresponds to '00b', it represents that the number of the associated data unit is 'Data Unit 0'. The data unit sequence number information 'b1b0' corresponding to '01b' represents 'Data Unit 1', whereas the data unit sequence number information 'b1b0' corresponding to '10b' represents 'Data Unit 2'. On the other hand, 15     the data unit sequence number information 'b1b0' corresponding to '11b' represents 'Data Unit 3'.

20      In addition to the above-described information, regional playback control information (not shown) may be recorded. Optical discs recorded with such regional playback control information cannot be played back in a particular optical recording/reproducing apparatus.

25      Meanwhile, the 2-bit layer information may be substituted with disc type information, as shown in Fig. 6. For example, where the disc type information 'b7b6' corresponds to '00b', it represents a BD-ROM type. Also, the disc type information 'b7b6' corresponding to '01b' represents a BD-R (Blu-ray Disc Recordable), whereas the disc type information 'b7b6' corresponding to '10b' represents a

BD-RE.

Also, diverse additional information corresponding to sector information, as used in DVDs, may be repeatedly recorded in the remaining information fields  $I_{n,1}$  to  $I_{n,15}$  ( $n = 0, 1, 2, 3$ ) of each data unit, in order to stably read the additional information.

In accordance with a second embodiment of the present invention, diverse additional information required to enable a normal data recording or reproducing operation may also be recorded in an address unit written on the high-density optical disc.

As shown in Fig. 7, an address unit having a size of 16 addresses  $\times$  9 bytes (rows) is recorded on the high-density optical disc. Meanwhile, diverse additional information corresponding to sector information, as used in a DVD and described above in conjunction with Fig. 2, is recorded in a particular 1-byte address field of the address unit, for example, an address field corresponding to a row number of '4' and an address number of 'S',  $AF_{4,S}$  ( $S = 0, 1, \dots, 15$ ).

As shown in Fig. 8, the additional information recorded in the address field  $AF_{4,S}$  may be disc reflectivity information, zone type information, data type information, and disc type information, each of which has a size of 2 bits. Here, the disc reflectivity information and disc type information are the same as those described above.

Where the zone type information corresponds to '00b', it represents that the current position corresponds to a data zone. The zone type information corresponding to '01b' represents an inner zone, whereas the zone type information corresponding to '10b' represents an outer zone. The zone type information is linked to the layer number information recorded in a state of being included in a physical ADIP

address.

For example, where the zone type information corresponds to '01b' representing an inner zone under the condition in which the current layer is determined to be the first layer of a dual layer structure, based on the layer number information, the current position corresponds to the lead-in zone of the first layer. On the other hand, where the zone type information corresponds to '01b' representing an inner zone under the condition in which the current layer is determined to be the second layer of a dual layer structure, the current position corresponds to the lead-out zone of the second layer.

Meanwhile, where the data type information corresponds to '00b', it represents that the associated main A/V data is read-only data. Also, the data type information corresponding to '01b' represents recordable data, whereas the data type information corresponding to '10b' represents rewritable data.

Also, where the disc type information corresponds to '00b', it represents that the associated optical disc is a BD-ROM. On the other hand, the disc type information corresponding to '01b' represents a BD-R, whereas the disc type information corresponding to '10b' represents a BD-RE.

Meanwhile, layer information of 2 bits representing the current layer may be recorded in place of the data type information, in addition to the layer number information recorded in a state of being included in a physical ADIP address. Where the layer information corresponds to '00b', it represents that the current layer is a first layer Layer 0. Also, the layer information corresponding to '01b' represents a second layer Layer 1, whereas the layer information

corresponding to '10b' represents a third layer Layer 2. On the other hand, the layer information corresponding to '11b' represents a fourth layer Layer 3. Alternatively, the layer information may represent the number of layers included in the associated disc.

5 It is also possible to perform desired control operations when a recording or reproducing operation is carried out, using the additional information according to the present invention in a state of being linked to the layer information. For example, although the layers of a high-density optical disc may be different from one another  
10 in terms of tracking control method, disc reflectivity, and data type, it is possible to carry out a stable recording or reproducing operation by performing a control operation by the unit of layers, based on the additional information.

When a BD-RE or BD-ROM according to the first embodiment of the  
15 present invention is loaded in an optical disc apparatus including an optical pickup 11, a VDR (Video Disc Recording) system 12, and an encoder 13, as shown in Fig. 10, the optical disc apparatus preferentially accesses the BCA of the optical disc, and reads the reflectivity information recorded in the first information field of  
20 each data unit, thereby performing OPC and AGC operations. Also, the optical disc apparatus reads the layer information and disc type information recorded in the first information field of each data unit, so that it carries out a normal data recording or reproducing operation, based on the read information.

25 On the other hand, when a BD-RE or BD-ROM according to the second embodiment of the present invention is loaded in the optical disc apparatus, the optical disc apparatus reads the reflectivity

information, zone type information, data type information and disc type information recorded in the address unit of the optical disc while performing a data recording or reproducing operation thereof, so that it normally carries out the data recording or reproducing 5 operation, based on the read information.

Alternatively, the additional information according to the present invention may be recorded in a state of being included in file system data or navigation data recorded at the leading position of the data area on an optical disc. Where this method is combined 10 with the method according to the first or second embodiment of the present invention, so as to record the additional information in both the leading position of the data area and the BCA or address unit, it is possible to perform a desired control operation using the information before and/or during the data recording or reproducing 15 operation.

As apparent from the above description, the present invention provides a high-density optical disc and a recording/reproducing method thereof which enable optimal optical power control and automatic gain control or identification of a current position, while 20 enabling a normal data recording or reproducing operation corresponding to the type of the optical disc.

Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions 25 are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.